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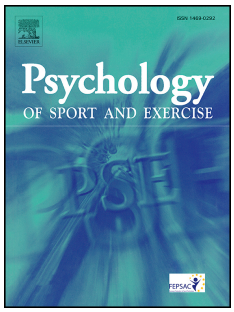

Motivational, volitional and multiple goal predictors of walking in people with type 2 diabetes

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Title: Motivational, Volitional and Multiple Goal Predictors of Walking in People with Type 2 Diabetes

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Title: Motivational, Volitional and Multiple Goal Predictors of Walking in People with Type 2 Diabetes

List of Abbreviations:

CSO[1]**,**

DSME[2]**,**

HAPA[3]**,**

IPAQ[4]**,**

IQR[5]**,**

MET[6]**,**

NRES[7]**,**

SDRN[8]**,**

SIGN[9]**,**

SPSS[10]**,**

TDF[11]**,**

WHO[12]

[1] Chief Scientist Office
[2] Diabetes Self-Management Education
[3] Health Action Process Approach
[4]International Physical Activity questionnaire
[5]Interquartile range
[6] Metabolic Equivalent of Task
[7]North of Scotland Research Ethics Committee
[8]The Scottish Diabetes Research Network
[9]The Scottish Intercollegiate Guidelines Network
[10]Statistical Package for the Social Sciences
[11]Theory Domain Framework
[12] World health Organization

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ABSTRACT

Background: Type 2 diabetes is a major public health problem. Effective diabetes self-management involves people engaging in multiple health behaviours, including physical activity. Walking is an effective, accessible and inexpensive form of physical activity, yet many people with Type 2 diabetes do not meet recommended levels. The present study aimed to: 1) identify demographic, motivational and volitional factors predictive of walking in people with Type 2 diabetes mellitus, and 2) test whether accounting for the perceived impact of other goal pursuits (goal facilitation and goal conflict) improved the prediction of walking.

Methods: A theory-based cross-sectional study using the Health Action Process Approach was conducted in adults with Type 2 diabetes across Scotland. Assuming a 50% response rate 1000 questionnaires were mailed to achieve the target sample size (N=500). Demographic information was collected, and intentional (outcome expectations, social support, risk perceptions), motivational (intention, self-efficacy), volitional (action planning, action control) and multiple goal (goal conflict, goal facilitation) factors were assessed as predictors of physical activity in general and walking specifically.

Results: The final sample comprised 411 respondents. The majority (60%) were non-adherent to physical activity recommendations. Of 411 respondents, 356 provided walking data. Body Mass Index and age were the only demographic and anthropometric factors predictive of walking (overall R^2 = 0.04). When motivational factors were added, intention and self-efficacy added to the prediction (overall R^2 = 0.07). When volitional factors were added, only action control was predictive of walking (overall R^2 = 0.08). Finally, goal facilitation explained an additional 7% variance in walking when added to the model (final overall R^2 = 0.15).

Conclusion: There was low adherence with physical activity recommendations in general and walking in particular. When testing predictors of motivational, volitional and competing goal constructs together, action control and goal facilitation emerged as predictors of walking. Future research should consider how walking can be embedded synergistically alongside other goal

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pursuits and how action control may help to ensure that they are pursued.

Keywords: Physical activity, Type 2 Diabetes Mellitus, Walking, Motivation, Volition, Goal Facilitation, Goal Conflict, Action Control, Health Action Process Approach.

BACKGROUND

Diabetes is a common non-communicable chronic disease. The global prevalence of 8.3% is expected to increase to 10.1% by 2030 (IDF, 2013). In Scotland, the prevalence of diabetes is 4.7%, slightly above the UK average (S D. S. M. Group, 2012). Almost 90% of patients with diabetes have Type 2 diabetes (WHO, 2006) and their life expectancy is up to 10 years less than people without Type 2 diabetes (Diabetes UK, 2012).

Diabetes is a chronic, metabolic disease characterized by increased levels of blood sugar. Diabetes occurs either when the pancreas produces no or insufficient insulin, or when the body cannot effectively use the insulin it produces. Type 2 diabetes results from the body's insufficient production and/or ineffective use of insulin. Hyperglycaemia (an increased concentration of glucose in the blood) is a common effect of uncontrolled diabetes and over time leads to serious damage to the heart, blood vessels, eyes, kidneys, and nerves (WHO, 2015).

Type 2 diabetes has non-modifiable (genetic) and modifiable (environmental and behavioural) risk factors (Alberti, Zimmet, & Shaw, 2007). Genetic predisposition is aggravated by behavioural factors including smoking, being overweight, abdominal obesity and lack of physical activity (Stumvoll, Goldstein, & van Haeften, 2005). Good management of these behavioural factors can prevent or delay onset of diabetes, and many of its complications (WHO & IDF, 2004). The recommended regimen for managing Type 2 diabetes includes eating healthily, being physically active (moderate intensity) for at least 30 minutes on most days, smoking cessation, and taking

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medication (e.g., oral hypoglycaemic drugs, insulin, antihypertensive and lipid lowering drugs) (D. P. P. R. Group, 2002; Hallal et al., 2012; WHO, 2012; Zimmet, Alberti, & Shaw, 2001).

Evidence suggests that regular physical activity reduces the risk of coronary heart disease, stroke, diabetes, hypertension, colon cancer, breast cancer and depression and is the main factor in weight control (WHO, 2010). For example, trials have demonstrated the benefits of undertaking physical activity in preventing Type 2 diabetes, improving glycaemic control and aerobic fitness, as well as decreasing the risk of cardiovascular disease and overall mortality (Sigal, Kenny, Wasserman, Castaneda-Sceppa, & White, 2006). Physical inactivity is the fourth leading risk factor for mortality worldwide, accounting for 6% of deaths (WHO, 2010), and approximately 30% of the disease burden due to diabetes and ischemic heart disease (WHO, 2010).

There is evidence to suggest that patients with Type 2 diabetes engage in even less physical activity than the general population (39% versus 58%) (Morrato, Hill, Wyatt, Ghushchyan, & Sullivan, 2007), and the level of physical activity in those who do participate is low (Badenhop, 2006). However there is wide inter-country variation, with recent studies showing that adherence to recommended physical activity in Type 2 diabetes ranges between 9% and 69% (Broadbent, Donkin, & Stroh, 2011; Morrato et al., 2007; Nelson, Reiber, & Boyko, 2002; Plotnikoff, Brez, & Hotz, 2000; Serour, Alqhenaei, Al-Saqabi, Mustafa, & Ben-Nakhi, 2007; Shultz, 2001; Thomas, Alder, & Leese, 2004). A World Health Organization (WHO) report showed that adherence with physical activity recommendations by people with Type 2 diabetes ranged from 7.7% to 55% across different countries (WHO, 2003). The high prevalence of Type 2 diabetes, along with low level of physical activity, highlights the need for new approaches to improve an individual's adherence to physical activity recommendations. These new approaches need to be acceptable, accessible and inexpensive to increase the probability of adoption.

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Walking as a specific form of physical activity

Walking is the most common form of physical activity and is an important component of total physical activity in adult populations (Monteiro et al., 2003; Morris & Hardman, 1997). Walking is acceptable, accessible and inexpensive; it requires no specific facilities, can be integrated easily into a daily routine, and is generally safe (Monteiro et al., 2003; Morris & Hardman, 1997). The energy expenditure of walking at a moderate pace of 5 km/hour (3 miles/hour) can meet the definition of moderate intensity physical activity (Ainsworth et al., 2000). However, data from the National Health and Nutrition Examination Survey on 2896 patients with Type 2 diabetes in the US showed that 46% of participants did not report any walking for exercise (Gregg, Gerzoff, Caspersen, Williamson, & Narayan, 2003). While the literature to date on behavioural determinants of physical activity focuses on more generic descriptions of physical activity, given the above-mentioned benefits of walking, our aim was to focus specifically on understanding the factors associated with walking in people with Type 2 diabetes.

Behavioural Determinants of Physical Activity

There is a large body of evidence on the biological, sociological, psychological, and environmental factors that influence physical activity (Bonner, 2010). Non-modifiable factors (e.g., age, gender) can help to identify sub-groups that are likely to be physically inactive, whereas modifiable factors (e.g., intention, self-efficacy) provide potential targets for increasing physical activity (Schwarzer 2008; Wing et al., 2001).

A number of theories summarise the relationship between modifiable factors and behaviour to generate testable hypotheses. The Health Action Process Approach (HAPA) (Schwarzer, 1992) is a comprehensive social cognition model which accounts for motivational factors including outcome expectation, social support, risk perceptions, intention, and self-efficacy, and as well as

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120 contemporary theoretical development in volitional (post-intentional) processes including action
121 planning and action control (Schwarzer 2008).
122
123 The HAPA describes intention as a function of self-efficacy, outcome expectations and risk
124 perceptions. Intentional processes are then related to action via volitional processes involving
125 planning and action control, further supported by self-efficacy and impacted by available barriers
126 and facilitators such as social support (Schwarzer et al., 2003). Self-efficacy is a main influential
127 factor, referring to a person's perceived capability of performing a desired behaviour (Schwarzer et
128 al., 2003). Outcome expectations refer to perceived positive and negative outcomes of engaging in
129 the health behaviour; the more the beneficial outcomes and the fewer the negative outcomes that are
130 perceived, the more likely it is that an individual will intend to engage in the behaviour (Schwarzer
131 et al., 2003). Risk perceptions refer to the minimum level of perceived risk, which must exist before
132 an individual starts to consider the benefits of possible behaviour and their capability to undertake
133 those behaviours.
134
135 Strong intention is an often necessary but rarely sufficient precondition for action (Orbell &
136 Sheeran, 1998). Post-intentional (volitional) processes such as action planning and action control
137 can help to ensure intentions are translated into action. Action planning involves linking goal-
138 directed action to environmental cues by specifying the when, where, whom, and how to enact a
139 behaviour to help translate intention into action (Darker, French, Eves, & Sniehotta, 2010;
140 Gollwitzer, 1999). In addition, more active self-regulatory efforts can further supplement the
141 translation of intention into action. Action control, i.e., self-monitoring of behaviour, being aware of
142 monitoring standards and expending effort in goal pursuit, is a self-regulatory process for ensuring
143 intention enactment (Carver & Scheier, 1982; Sniehotta., Scholz, & Schwarzer, 2005).
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The HAPA has been applied to understand physical activity across numerous studies. Some studies focus on the entire HAPA model (Barg et al., 2012; Bonner, 2010; Caudroit, Stephan, & Le Scanff, 2011; Renner, Spivak, Kwon, & Schwarzer, 2007; Scholz, Schuz, Ziegelmann, Lippke, & Schwarzer, 2008; Scholz, Sniehotta, & Schwarzer, 2005; Schwarzer 2008; Schwarzer et al., 2007; Sniehotta. et al., 2005), whilst others focus on more specific components of the model (Barg et al., 2012; Lippke, Ziegelmann, & Schwarzer, 2005; Schwarzer et al., 2007; Sniehotta, Scholz, & Schwarzer, 2006; Sniehotta, Schwarzer, Scholz, & Schüz, 2005). Few studies have applied the HAPA to the behaviour of people with Type 2 diabetes. Bonner (Bonner, 2010) used the HAPA in Type 2 diabetes and showed that self-efficacy and outcome expectations were predictive of physical activity intention, and intention (but not self-efficacy or action planning) predicted physical activity levels. No study has yet used the HAPA model to understand physical activity in people with Type 2 diabetes focusing specifically on walking as an inexpensive and accessible form of physical activity (Lippke & Plotnikoff, 2014).

Towards multiple behaviour approaches

Most popular social cognition models of health behaviour focus on understanding a single health behaviour at a time. The ecological validity of such an approach has increasingly been questioned (Presseau, Tait, Johnston, Francis, & Sniehotta, 2013). In everyday life, individuals pursue multiple goals and perform multiple behaviours alongside the single health behaviour that is typically the focus of tests of behavioural theory. These goal pursuits compete for time and energy such that pursuit of some may help and/or hinder the pursuit of a particular health behaviour, such as physical activity in general or walking specifically.

The extant literature has predominantly managed the concept of considering multiple goals by focusing on the impact of goal conflict on health behaviour. Goal conflict can be described as

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occurring when the pursuit of multiple personal goals leads to situations where they interfere with one another. For instance, working, childcare, relaxing and socialising may be common personal goals that have the potential to conflict with walking by taking available leisure time, energy or other resources that might otherwise be used go for a walk. The evidence on the link between goal conflict on physical activity-related behaviour is mixed. There is a lack of support for this relationship in between-subject predictive studies (Li & Chan, 2008; Presseau, Sniehotta, Francis, & Gebhardt, 2010; Riediger & Freund, 2004). However, a study investigating actual time spent pursuing goals that conflict with physical activity within-subjects was negatively predictive of objectively assessed physical activity (Presseau et al., 2013), and a study investigating goal conflict in more resource constrained contexts has also shown that goal conflict is negatively predictive of behaviour (Presseau, Francis, Campbell, &Sniehotta, 2011). As people with Type 2 diabetes engage in self-management regimens that inherently involve pursuing multiple behaviours and goals, it is plausible that goal conflict may be a useful additional construct in this population.

By comparison, goal facilitation has received less research than goal conflict, yet is recurrently shown to be predictive of physical activity-related behaviours. Goal facilitation involves instances where the pursuit of other personal goals sets the stage or makes it more likely that physical activity will take place (e.g. socialising with friends that involves walking in the park), or inherently involves physical activity (e.g. commuting to work can be facilitative of physical activity when involving active travel). The presumption is that the more one's other personal goals are aligned with physical activity, the greater the physical activity. Goal facilitation has been demonstrated to positively predict physical activity (Riediger & Freund, 2004), a relationship that is maintained even when controlling for intention and self-efficacy (Presseau et al., 2010). However, it is not clear whether these relationships persist when accounting for volitional (planning, action control) processes, which could in themselves involve managing competing goals. For instance, action

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planning may involve describing other goals that facilitate engaging in physical activity, whereas coping planning may involve identifying barriers that in themselves are actually competing goal pursuits (Presseau, Boyd, Francis, & Sniehotta, 2015). This conceptual overlap issue could be addressed empirically by investigating whether indicators of goal conflict or goal facilitation remain predictive of physical activity when controlling for volitional factors. Furthermore, it is not clear how either goal conflict or goal facilitation relate to walking behaviour specifically, which may have different levels of perceived conflict and facilitation than other forms of more intensive physical activity.

The present study aimed to: 1) identify demographic, motivational and volitional factors predictive of walking in people with Type 2 diabetes, and 2) test whether accounting for the perceived impact of goal pursuits (goal facilitation and goal conflict) improved the prediction of walking.

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Methods

This was a cross-sectional theory-informed postal questionnaire study undertaken with people with Type 2 diabetes from the Grampian and Tayside regions of Scotland. All English-speaking adults (>18 years) diagnosed with Type 2 diabetes were eligible to participate. Patients with serious end stage illness and patients with mental disability were excluded.

Questionnaire development

A qualitative study was initially conducted using the Theoretical Domains Framework (TDF) (Michie et al., 2005) to identify which theoretical domains and constructs were relevant to understanding the adherence of people with Type 2 diabetes to physical activity recommendations in general and walking in particular. The results were used to identify relevant items that were included in a draft questionnaire. The questionnaire explored physical activity in general, and walking in particular. Pre-piloting of the questionnaire was undertaken with five people using the "think aloud" method (Jones, 1989; Lundgren-Laine & Salantera, 2010) where participants verbalised their thoughts. Three participants with Type 2 diabetes were recruited from the Scottish Diabetes Research Network (SDRN) (see later) and three were colleagues with Type 2 diabetes in the Centre of Academic Primary. Minor revisions were made prior to the pilot study. The questionnaire was piloted with 50 people with Type 2 diabetes, selected randomly from the SDRN list, replicating the distribution process planned for the main survey (pre-notification letter, questionnaire and covering letter, and a reminder letter and replacement questionnaire after two weeks). To assess test-retest reliability, respondents were sent a second copy of the questionnaire two weeks after returning their first questionnaire.

Sample and Recruitment

The sample size for this study was influenced by two factors: 1) having acceptable precision for the

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estimation of adherence with physical activity (any precision within ± 5% that would be clinically and statistically acceptable) and 2) the resources (time and money) available to undertake the research. To achieve a balance between these two items, a sample size of 500 patients was required. As previous research has shown compliance with physical activity to range from 19-30% (midpoint: 25%) (Kamiya et al., 1995; Kravitz et al., 1993), this allowed estimation of adherence with physical activity of 25% with precision within ± 3.8% (95% *CI* 21.2% to 28.8%). Previous research in community samples indicated a 50% response rate was likely, therefore 1000 questionnaires were mailed to achieve the target of 500 evaluable responses.

Participants were recruited from the Scottish Diabetes Research Network (SDRN), a register of patients with diabetes in Scotland who have consented to be contacted about potential participation in research studies (SDRN, 2010). All SDRN registered patients in Grampian (*n*=388) were identified and invited to participate, supplemented by a random sample of 612 of the 1279 patients registered in Tayside exclusive of those who had taken part in the pilot study. A pre-notification letter with a reply slip, that they could use if they did not want any further communication,was sent to these 1000 patients two weeks before the questionnaire and accompanying invitation letter were mailed. Two weeks after the first mailing, a reminder letter and another copy of the same questionnaire were sent to non-respondents. The questionnaire was piloted with 50 people with Type 2 diabetes, selected randomly from the SDRN list, replicating the distribution process planned for the main survey (pre-notification letter, questionnaire and covering letter, and a reminder letter and replacement questionnaire after two weeks). To assess test-retest reliability, respondents were sent a second copy of the questionnaire two weeks after returning their first questionnaire.

Measures

Physical activity and walking. The questionnaire included items assessing time spent being physically active in the last seven days based on the short version of International Physical Activity

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Questionnaire (IPAQ) (IPAQ, 2002). It measures physical activity over a short time frame. The IPAQ was developed by consensus in 1998-1999 with support from the WHO to enable the cross-national assessment of physical activity in adults aged 18-65 years (Craig et al., 2003; Macfarlane, Lee, Ho, Chan, & Chan, 2007; Papathanasiou et al., 2010). The short format of the IPAQ asks about three types of activity in the four domains. Walking, moderate-intensity activities and vigorous-intensity activities are the specific types of activity which are assessed by the IPAQ short form (IPAQ 2005). This version generates a total score by summation of the duration (in minutes per day) and frequency (days) of walking, moderate-intensity activities and vigorous-intensity activities. The IPAQ measures energy as Metabolic Equivalent of Task (MET). The IPAQ has been used in a number of international studies (Craig et al., 2003; Guthold, Ono, Strong, Chatterji, & Morabia, 2008) and acceptable reliability and validity has been reported (Craig et al., 2003; Hagstromer, Oja, & Sjostrom, 2006; Hallal et al., 2010; Macfarlane et al., 2007; Papathanasiou et al., 2010). An international reliability and validity test of the IPAQ was conducted in 14 centres in 12 countries and reported that it has acceptable reliability and validity at least equal to other established self-report tools for physical activity in diverse populations of 18-65 years (Craig et al., 2003). We focused specifically upon understanding predictors of walking as the primary outcome of interest given the wording of our predictors focused upon walking. Walking was assessed using the total time or energy (150 minutes or >600 MET minutes/week) spent on walking measured by the IPAQ and served as the dependent variable in all predictive analyses. However we also aimed to describe overall adherence to physical activity recommendations.

Adherence to physical activity was assessed by comparison with two different recommendations. Firstly it was assessed by comparison with the Scottish Intercollegiate Guideline Network /WHO (SIGN, 2010; WHO, 2010) advice of at least 150 minutes of vigorous/moderate (no walking

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included) combined physical activity per week (equal to at least 600 MET[13]). Secondly it was assessed accordingly to the IPAQ criterion of 600 MET minutes/week of any combination of walking, moderate-intensity or vigorous-intensity physical activities (IPAQ, 2002). According to IPAQ, <600 MET minutes/week, 600-2999 MET minutes/week, and >3000 MET minutes/week are considered as low, moderate and vigorous physical activity, respectively (IPAQ, 2002).

Predictors of walking

The questionnaire assessed a number of potential demographic and theoretical predictors of walking: demographic variables, self-efficacy, outcome expectations, risk perceptions, intention, action planning and control, social support, goal facilitation and goal conflict. The demographic variables age, gender, education, and employment items) were defined using the England household version of the 2001 Census questionnaire (OFNS, 2002). All theoretical items were worded according to the TACT principle (Target, Action, Context, and Time), specifying the behaviour of interest as: “To increase (my) own walking level by 20% during the normal daily routine in the forthcoming month” and described in detail below.

Self-efficacy. Self-efficacy was assessed using six items ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) in relation to perceived capability to increase walking despite the presence of barriers (Schwarzer et al., 2003). The stem “I am confident that I can increase my walking by 20% in the next month even if...." had response options such as: “the weather is bad", "it is hard for me physically", "I do not have much time".

Outcome Expectations. Two facets of outcome expectations were assessed (Schwarzer et al., 2003),

[13] Metabolic equivalent of task (MET) is a concept frequently used to show the amount of energy or oxygen the body uses during physical activity. One MET is equivalent to the energy or oxygen that the body uses at rest, or consuming 3.5 millilitres of oxygen /kg of body weight/minute (1 MET= 50 kcal/hours/m^2 body surface area) (Davis & Wilbrn, 2003).

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with scores for each item ranging from 1 (*not at all*) to 4 (*exactly true*): there were six items to assess positive outcome expectations, and three items to assess negative outcome expectations. The stem “if I increase my walking by 20% in the next month ...." had response options such as: “I would feel better afterwards", "it would take up a lot of time ".

Risk Perception. Risk perception refers to the respondent’s belief about their vulnerability to health problems, or specifically in this patient group for their diabetes to worsen (Schwarzer et al., 2003). Absolute and relative vulnerability were assessed using six items with response options ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The items measuring absolute vulnerability had a stem “If I am not physically active…" and response options such as: "... I am concerned that my health in general will become worse", "... I am concerned that my diabetes in general will become worse", "...I will worry about getting a serious medical condition". The items measuring relative vulnerability had a stem “If I am not physically active…" comparing myself with an average person of my age and sex, then I will be at higher risk of ..." and response options such as: " ... my diabetes gets worse", "...having a serious medical condition".

Intention. Intention refers to a participant’s intention to increase walking (Schwarzer et al., 2003) and was assessed by four items with response options ranging from 1 (*completely disagree*) to 5 (*totally agree*). Intention was measured by items such as "I intend to walk more in the next month" and " I am motivated to walk more to improve my health in general".

Action Planning. Action planning consisted of items assessing the extent to which participants had a plan about when, where, and how to increase their walking (Schwarzer et al., 2003). Action planning was assessed using four items (Sniehotta et al., 2005). All items had response options ranging from 1 (*completely disagree*) to 4 (*totally agree*). The stem “I have made a specific plan

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about ...." had response options such as : "...when to increase my walking in the next month" , "...where to increase my walking in the next month", " ...what to do if something interferes with my intention to increase my walking in the next month".

Action Control. Action control refers to perceived self-monitoring, awareness of standards and effort (Sniehotta. et al., 2005) to increase walking of participants. Action control was assessed using six items and all items had response options ranging from 1 (*strongly disagree*) to 4 (*strongly agree*). The stem "During the last week I ...." had response options such as:" …regularly thought about my intention to be regularly physically active", " …I have consistently checked to see whether I am physically active enough".

Social Support. Social support items assessed support from colleagues, friends and household members to increase walking using a modified version of the Molloy social support tool (Molloy, Dixon, Hamer, & Sniehotta, 2010). All items (17 items) had response options ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Social support (friends/colleague) was measured by items such as "I have a friend/colleague who thinks that I should increase my walking", and "I have a friend/colleague who encourages me to increase my walking". Social support (household) was measured by items such as "I have somebody to encourage me to increase my walking on the regular basis", and "I have somebody to walk with me".

Goal Conflict and Goal Facilitation. Goal conflict (5 items) and goal facilitation (3 items) items focus on the extent that a participant's personal goals conflicted with physical activity and were adapted from general goal conflict and facilitation scales (Riediger & Freund, 2004). All the items had response options ranging from 1 (*never, not at all, or completely disagree*) to 5 (*very often, a great deal, or completely agree*). The items measuring goal conflict consisted of a stem "How often

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does it happen that, because of the pursuit of another personal goal, you do not invest...." and response options such as : " ...as much time in participating in regular physical activity as you would like to?", "...as much energy in participating in regular physical activity as you would like to?" Goal facilitation was measured by items such as "To what extent do other things you do in everyday life help you to participate in regular physical activity?", and "How often does it happen that you do something in pursuit of a personal goal that is simultaneously beneficial for participating in regular physical activity?"

Data management and analysis

Data were entered into SPSS version 20 and 10% of all data were double entered and checked for quality assurance. Few errors (*n*=11 or 0.1% of entered fields) were identified and corrected, with no evidence of systematic errors.

The primary outcome measure was the IPAQ walking criterion (MET minutes/week). A sensitivity analysis was conducted using total MET minute/week. The extent of missing data varied across variables. The variables with the greatest and smallest amount of missing data were walking level (13.4%), and diabetes management method (2.1%). We used multiple imputation (Klebanoff & Cole, 2008) to account for missing data which addresses missing data issues in the most robust manner possible. All model testing was conducted on multiple imputed data and results presented as pooled estimates. Hierarchical multiple regression analyses were conducted to test the sequential contribution of demographic, motivational, volitional and multiple goal constructs as predictors of walking.

Ethics approval

Ethics approval for the study was granted by North of Scotland Research Ethics Committee (NRES) (Ref 10/S0802/4).

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Results

Response rate

Of 1000 people contacted, 35 withdrew at the pre-notification letter stage. Of the 965 questionnaires mailed, 426 were returned (compared to the target sample size of 500). Of these fifteen were excluded (five received after the agreed deadline (15/07/2012), seven with excessive (>90%) missing data, three because of participation in the pilot study). Most questionnaires (373/426; 87.6%) were returned by people who had responded to the pre-notification letter. No significant difference was found between participating and non-participating respondents in terms of gender and age suggesting the final sample was representative. The final evaluable sample comprised 411 respondents.

Socio-demographic characteristics of respondents

The mean age of respondents was 65.5 years (*SD* 9.7); 57.4% (*n*=236) were men. Most were married (60.6%), did not live alone (63.3%) or were retired (62.3%). A quarter (26%) had no formal educational qualification. Most participants (92.7%) were either overweight (BMI 25.0-29.9) or obese (BMI ≥ 30.0). The mean average BMI was 34.0 (*SD* 5.9) and 31.4 (*SD* 5.1) for women and men, respectively.

Descriptive statistics and bivariate correlations

As shown in Table 1, which presents findings across all 411 respondents, the mean total physical activity measured as Metabolic Equivalent of Task (METs) was 1732 minute/week (Inter Quartile Range (*IQR*) 485, 4398; median 200). Based on SIGN and WHO guidelines, which exclude walking, almost 60% (*n*=236) of patients did not adhere to physical activity recommendations (<600METs); however this proportion was reduced to 28% using the IPAQ (Metabolic Equivalent of Task (MET) minutes/week) measure which includes walking (Table 2). Men had higher median

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levels of physical activity than women. According to the IPAQ categories nearly 36% and 35% of participants reported moderate and vigorous levels of physical activity during the last week (Table 2), but the median time (hours/week) spent for both moderate and vigorous physical activity was zero (Table 1). The median duration of walking was 5.25 hours per week. The proportion of total physical activity reported as walking was 65.6%.

<Insert Table 1 here>

<Insert Table 2 here>

As shown in Table 3, which presents findings for the 356 respondents providing walking data, BMI, action planning, action control and goal facilitation were significantly associated with walking behaviour, and outcome expectations, social support, risk perceptions, self-efficacy, action planning, action control, and goal conflict were significantly associated with walking intention. The Cronbach's alpha of different subscales of HAPA questionnaire are presented in Table 3 indicating that most subscales of the questionnaire had a good internal consistency. The negative outcome expectations scale was omitted from any analyses due to low observed internal consistency.

<Insert Table 3 here>

Predicting walking

The hierarchical multiple regression was conducted in four steps. First, demographic factors and predictors of intention from the HAPA were included. Next, motivational factors from HAPA were added, then volitional, and finally multiple goal constructs. At each step, we tested whether the added factors contributed to explaining additional variance in walking beyond factors in the model from the previous steps, and which specific constructs explained this additional variance. In Step 1 of the hierarchical multiple regression, walking was regressed against demographic factors (BMI, age, sex) and HAPA theory-based predictors of intention (outcome expectations, social support and risk perception). As shown in Table 4, only BMI and age predicted walking, explaining 3.7% of the

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variance in walking. In Step 2, HAPA motivational constructs (intention and self-efficacy) were added, with intention and self-efficacy adding to the prediction (ΔR^2 = 0.03). In Step 3, the volitional constructs of action planning and action control were added, with only the latter adding significantly to the prediction (ΔR^2 = 0.01) and intention and self-efficacy no longer significantly contributing to predicting behaviour. In Step 4, the multiple goal constructs of goal conflict and goal facilitation were added, with the latter significantly adding to the prediction of behaviour (ΔR^2 = 0.07) whilst action control no longer significantly predicted behaviour.

<Insert Table 4 here>

Discussion

The study showed that the majority (60%) of Type 2 diabetic patients were non-adherent to physical activity recommendations as defined by SIGN/WHO. Most of the physical activity undertaken by people with Type 2 diabetes was walking (65.6%). Action control and goal facilitation were predictive of walking. Goal facilitation explained a further 7% of the walking variance.

Non-compliance of the majority of respondents with the SIGN recommendation (SIGN, 2010), for physical activity is consistent with the Scottish Health Survey (The. Scottish Government, 2012) which showed that 61% of the general population aged 16 and over did not meet physical activity recommendations. Other evidence suggests that patients with Type 2 diabetes may be even less physically active than the general population (Morrato et al., 2007). This was also the finding of a study in USA of 23,283 adults, which showed that only 39% of individuals with Type 2 diabetes were physically active compared with 58% of those without diabetes (Morrato et al., 2007).

The median duration of walking reported in the current study was 5.25 hours per week (IQR 1.5, 12). The proportion of walking as a percentage of total physical activity was 65.6% suggesting that

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in some cases walking was the main type of physical activity undertaken by patients. This finding reflects the behaviour of the general adult population (Monteiro et al., 2003; Morris & Hardman, 1997); therefore developing and evaluating interventions to increase and maintain this behaviour are important. Walking is a common, accessible, inexpensive Type of physical activity. Walking provides diverse health benefits of physical activity with few adverse effects. There is a large body of evidence about the positive effect of walking to improve health in people with Type 2 diabetes. This suggests that focusing on walking as a form of physical activity to improve peoples' adherence with physical activity recommendations is important and could be an effective way to improve physical activity.

In terms of the existing literature one study conducted with cardiac rehabilitation patients, was found that measured action control as a predictor of physical activity (Sniehotta. et al., 2005). That study reported that each of the three factors of planning, self-efficacy and action control made unique contributions to translating intention into action (Sniehotta. et al., 2005). A study conducted in students confirmed associations specified by the HAPA at the intrapersonal level: outcome expectancies and self-efficacy, but not risk awareness, were positively associated with intentions for physical exercise. Physical activity was positively associated with intentions, self-efficacy, action control, but not with action planning (Scholz, Keller, & Perren, 2009). These findings are in accordance with the results of this current study. Another study conducted in Type 2 diabetic patients participating in a Diabetes Self-Management Education (DSME) (Bonner, 2010) showed that self-efficacy was the strongest predictor of behavioural intention, followed by positive outcome expectancy. The study (Bonner, 2010) revealed that behavioural intention, but not self-efficacy and action planning could significantly increase initiation of a minimum level of physical activity.

The current study showed some degree of support for the tenets of the HAPA, whilst demonstrating

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480 the importance of considering multiple goal pursuit in people with Type 2 diabetes. The majority of
481 respondents did not engage in physical activity at recommended levels. Action control and goal
482 facilitation were shown to be predictors of physical activity when considered alongside other HAPA
483 and demographic factors. Findings in relation to the HAPA with respect to intention (step 2 of the
484 regression) and action control (step 3) were consistent with previous research (Sniehotta. et al.,
485 2005) and extend these findings by demonstrating the role for multiple goals constructs on physical
486 activity (in this case, goal facilitation). Conversely we did not show a predictive role for action
487 planning and in step two, there is an unexpected negative predictive relationship between self-
488 efficacy and walking behaviour, although this becomes insignificant when the additional predictors
489 in steps three and four are added. Both findings are at odds with the HAPA model and most of the
490 literature investigating these relationships (Sniehotta et al., 2005). Self-efficacy showed no
491 significant bivariate relationships with walking which may be due to the fact that the target
492 behaviour was 'increasing walking by 20%' which equates to large absolute changes for more
493 active respondents. Moreover, self-efficacy was significantly correlated with intention, so that the
494 negative beta-coefficient in the second step of the hierarchical regression analysis may be reflective
495 of an artefact, a statistical suppressor effect. Action planning showed a weak bivariate correlation
496 with walking and was significantly correlated with action control so that when action control was
497 simultaneously controlled for, there was not a unique predictive relationship between action
498 planning and walking. In the final model, neither of these variables was significant.
499
500 Findings regarding multiple goal constructs are also consistent with earlier research showing that
501 perceived goal facilitation but not perceived goal conflict were predictive of physical activity
502 (Presseau et al., 2010; Presseau et al., 2013; Riediger & Freund, 2004).
503
504 There is now growing evidence across a range of studies with diverse populations that particularly

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support the role of goal facilitation as a key factor in physical activity and, with the present study's findings, walking specifically. Goal facilitation is an indicator of the extent to which a target behaviour (in this case, walking) "fits" synergistically alongside the other behaviours and goals that individuals pursue in daily life. Findings from this study continue to support the role of goal facilitation and also underscore its potential importance in understanding health behaviours; indeed, even when controlling for predominant theoretical constructs reported in the literature, the relationship between goal facilitation and walking robustly accounted for additional variability in walking. With increasing recognition of the importance of considering the wider context of multiple goal pursuit when understanding performance of a given health behaviour, the present study further contributes evidence suggesting that goal facilitation may be a key indicator in the move towards developing models that explicitly account for the impact of multiple goal pursuit.

There is also mounting lack of support for the role of goal conflict in understanding physical activity. There may be a range of reasons for this. For instance, when considering the totality of an individual's goal pursuits, individuals may be better able to perceive helpful goal relationships than conflicting ones. Individuals may not be aware of the extent that their competing goals interfere with their physical activity. When using diaries to assess actual time spent in pursuit of goals that conflict with physical activity over time, goal conflict has been shown to be predictive of objectively assessed physical activity (Presseau et al., 2013). This suggests that measures of perceived goal conflict may need to be supplemented with behavioural assessments. This also presents opportunities for feedback interventions by showing individuals which of their behaviours is most interfering with their physical activity. In addition, when focusing the goal pursuit context to a specific time and place rather than all of everyday life, both goal conflict and goal facilitation have been shown to predict behaviour (Presseau et al., 2011).

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The utility of the HAPA to explain and possibly predict adherence with physical activity in addition to the demonstrated added contribution of considering goal facilitation suggests clear opportunities for developing and evaluating novel, theory-based interventions for promoting walking in people with Type 2 diabetes. The present study extends the literature by demonstrating the role of multiple goal pursuit and goal facilitation in particular in a population sample of people with Type 2 diabetes. In addition, the findings extend the theoretical literature by demonstrating that goal facilitation predicts independent variability in health behaviour over and above all contemporary single-behaviour cognitions. This is important as it provides further evidence for moving beyond on of health behaviours in isolation. This study is the first to specifically consider the role of goal facilitation in relation to walking by people with Type 2 diabetes.

The importance of goal facilitation as a key predictor of walking, points to possible interventions to increase walking behaviour. Indeed, Darker et al (Darker et al., 2010) used a variation of action planning – facilitation planning – in their walking intervention, which was successful in increasing and maintaining the increased walking behaviour. Planning when, where and how to perform behaviours may facilitate action. To some extent, these may be preparatory behaviours, but goal facilitation encompasses the broader spectrum of valued goals pursued in everyday life and may not necessarily be preparatory in nature, whereas preparatory behaviours may not have any intrinsic value to the actor. Nevertheless, the functional similarities between preparatory behaviours and goal facilitation are noteworthy and future research should consider these two constructs in more detail.

Strengths and limitations

The present study is strengthened by its large sample size, robust development and inclusion of theoretical factors as determinants of walking. Although the sample of 411 (356 for the main analysis) was slightly short of the target of 500, this did not impact substantially upon the precision

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of the estimates achieved: 40% with precision within ±4.7% (95% *CI* 35.3% to 44.7%) of respondents being categorised as adherent with physical activity recommendations compared with the original estimate of 25% with precision within ± 3.8% (95% *CI* 21.2% to 28.8%).

The study also had limitations. Firstly, the cross-sectional study design only allows association, and not causation, to be inferred. While there is no obvious suggestion of multicollinearity, the modest bivariate correlations between predictors in the model should be considered in interpreting the relative contribution of predictors in the model, particularly with respect to factors which were not zero-order correlations, and were not bivariately associated with walking but which were associated with walking when included in the multivariate analyses (i.e. age and self-efficacy). Future research should aim to replicate findings using a prospective design or by embedding such questionnaires in a theory-based process evaluation alongside a trial (Sedgwick, 2014).

A further limitation is that the study may have overestimated levels of physical activity in people with Type 2 diabetes. People living in Grampian and Tayside have slightly better self-reported general health than the total population of Scotland (72% and 69.6% in Grampian and Tayside, respectively versus 67.9% in Scotland) (The Scottish Census, 2011). Therefore, their self-reported physical activity, used as the main outcome in this study, may also be higher than the general national population. A further cause of over estimation could be that due to the patient population in the current study i.e. patients with Type 2 diabetic registered with the SDRN may be more engaged with their disease management compared with patients not registered with the SDRN. Social desirability bias could also contribute to any over-estimation of self-reported physical activity. The IPAQ has in fact been shown to overestimate self-reported time spent in physical activity compared with accelerometer measured activity (Ekelund et al., 2006; Hallal et al., 2012).

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The assessment of physical activity in the population (van Hees, 2012) is challenging. Some tools include any type of walking as a physical activity (e.g. the IPAQ) (IPAQ, 2002) whereas other scales (e. g. The Rapid Assessment of Physical Activity [RAPA]) (University of Washington, 2006) do not. The recommended level of physical activity is at least 150 minutes of vigorous/moderate combined physical activity, in both SIGN and WHO guidelines (WHO, 2010). If walking is considered a physical activity, (SIGN, 2010) 72% of participants were compliant with the guidance, but this reduces to 40% if walking is not included, as in the SIGN guideline. This demonstrates the variation which arises when different tools are used. The use of an internationally relevant and valid tool allows comparisons to be made across studies.

Finally, items for some constructs (risk perceptions, action control, goal conflict, goal facilitation) were measured in reference to physical activity, whereas others (outcome expectancies, social support, action planning, intention and self-efficacy) referred specifically to walking. While no obvious pattern of association seemed to preference one or the other conceptualization and walking is inherent to physical activity, future research could ensure greater correspondence of all items with walking.

Conclusions

Low physical activity in people with Type 2 diabetes is an important factor in terms of disease management. The majority of respondents did not engage in physical activity or walking at recommended levels. When testing motivational, volitional and competing goal constructs together as predictors of walking, Action Control and Goal Facilitation were shown to predict walking and could form the basis for developing novel, theory-based interventions for promoting walking in people with Type 2 diabetes.

Competing interests

The authors declare that they have no competing interests.

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Table 1

Descriptive Statistics for Different Type of Physical Activity

Characteristic	n	Median (*IQR*)	Range
Total Physical activity (MET minute/week)	403	1732 (485, 4398)	0-29460
Total time spent on each physical activity (Hours/week)	403	9 (3.2, 20)	0-112
Vigorous Physical activity	371	0 (0, 2)	0-49
Moderate physical activity	371	0 (0, 4)	0-57
Walking	356	5.25 (1.5, 12)	0-77

Note. IQR= Interquartile range.

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Table 2

Descriptive Statistics of Compliance with Physical Activity Based on IPAQ measure and SIGN/WHO guideline

Characteristic	**Percentage (%)**	**Frequency (*n*)**
Physical activity (*N*=403)		
Low physical activity (<600 MET min/week)	28.0	115
Moderate physical activity (600- 3000 MET min/week)	35.8	147
Vigorous physical activity (>3000 MET min/week)	34.3	141
IPAQ *(N*=403)		
Non-Compliant (<150 minute any physical activity /week)	28.0	115
Compliant (>150 minute any physical activity /week)	72	288
SIGN/ WHO *(N*=392)		
Non-Compliant (<150 minute vigorous & moderate physical activity /week)	60.2	236
Compliant (>150 minute vigorous, moderate physical activity /week)	39.8	156

Note. IPAQ= International Physical Activity Questionnaire; SIGN= The Scottish Intercollegiate Guidelines Network; WHO= World Health Organization.

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Table 3

Correlations and descriptive statistics of study variables for walking (N=356; pooled estimates)

	Walking (Sqrt)	BMI	Age	Sex	Outcome Expectations	Social Support	Risk Perceptions	Intention	Self-efficacy	Action Planning	Action Control	Goal Facilitation	Goal Conflict
BMI	-.13*												
Age	-.06	-.29**											
Sex	.05	.22**	-.06										
Outcome	-.01	.12*	-.15**	.08									
Social Support	.01	-.10	-.04	-.04	.14*								
Risk Perceptions	-.05	.14**	-.18**	.05	.34**	.16**							
Intention	.10	.03	-.11*	.06	.55**	.30**	.27**						
Self-efficacy	-.08	.08	-.11*	-.01	.09	-.04	.23**	.28**					
Action Planning	.11*	.02	-.06	.06	.39**	.30**	.15**	.65**	.20**				
Action Control	.14**	<.01	.06	.06	.23**	.22**	.21**	.39**	.04	.44**			
Goal Facilitation	.29**	-.13*	.06	-.05	-.06	.13*	.07	.05	.01	.13*	.34**		
Goal Conflict	-.10	.16**	-.22**	.06	.31**	.13*	.26**	.21**	.12*	.07	-.05	-.11*	
Mean	33.50	32.70	65.24		2.97	4.06	5.02	3.63	2.99	2.40	2.60	3.04	2.80
Cronbach's alpha					0.88	0.83	0.92	0.92	0.68	0.88	0.86	0.67	0.84

Note. Sqrt=Square root transformed; BMI= Body Mass Index.
* p<.05. ** p<0.01.

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Table 4

Pooled hierarchical multiple regression results on walking only (N=356)

			Unstandardised Coefficients		Sig.	95% *CI*	
Variables	**med R^2**	**med ΔR^2**	***B***	***SE***		**LL**	**UL**
Step 1– Demographics Factors& Predictors of Intention	0.04						
BMI**			-.74	.24	<.01	-1.20	-.27
Age*			-.28	.13	.04	-.53	-.02
Sex			3.86	2.50	.12	-1.05	8.77
Outcome Expectations			.06	1.93	.98	-3.74	3.85
Social Support			-.02	.88	.98	-1.79	1.74
Risk Perceptions			-.84	.89	.35	-2.59	.91
Step 2- Predictors of Motivation	0.07	0.03					
BMI**			-.70	.23	<.01	-1.16	-25
Age*			-.29	.13	.03	-.54	-.03
Sex			3.43	2.49	.17	-1.46	8.31
Outcome Expectations			-3.06	2.23	.17	-7.43	1.32
Social Support			-.73	.93	.44	-2.60	1.15
Risk Perceptions			-.67	.90	.46	-2.44	1.10
Intention**			5.61	2.08	.01	1.53	9.69
Self-efficacy*			-3.59	1.83	.05	-7.17	-.01
Step 3 – Predictors of Volition	0.08	0.01					
BMI**			-.72	.23	<.01	-1.17	-.20
Age*			-.32	.13	.01	-.58	-.07
Sex			3.12	2.48	.21	-1.75	7.99
Outcome Expectations			-3.20	2.22	.15	-7.56	1.16
Social Support			-1.00	.98	.31	-2.99	.98
Risk Perceptions			-.87	.91	.34	-2.65	.91
Intention			3.18	2.40	.19	-1.54	7.91
Self-efficacy			-3.42	1.84	.06	-7.02	.18
Action Planning			2.38	2.61	.36	-2.75	7.50
Action Control*			4.97	2.37	.04	.33	9.62
Step 4- Multiple Goals	0.15	0.07					
BMI*			-.57	.22	.01	-1.01	-.12
Age**			-.34	.13	.01	-.59	-.09
Sex			3.62	2.40	.13	-1.08	8.32
Outcome Expectations			-1.64	2.23	.46	-6.01	2.72
Social Support			-1.17	.99	.25	-3.20	.86
Risk Perceptions			-1.00	.88	.26	-2.73	.73
Intention			4.11	2.31	.08	-.42	8.65
Self-efficacy			-3.47	1.78	.052	-6.97	.02
Action Planning			1.64	2.50	.51	-3.27	6.55
Action Control			0.81	2.42	.74	-3.93	5.55
Goal Facilitation**			7.78	1.57	<.01	4.69	10.86
Goal Conflict			-1.46	1.50	.33	-4.41	1.49

Note. CI=.Confidence Interval; Med= median across imputed samples; SE= Standard Error; LL=Lower Limit; UL= Upper Limit; BMI= Body Mass Index.

** p<0.01; * p<.05.

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Highlights

- Tested factors from the Health Action Process Approach (HAPA) as predictors of walking in national sample of people with type 2 diabetes

- Tested the added utility of considering the perceived impact of competing and facilitating behaviours on walking alongside factors from the HAPA

- Demonstrated that physical activity level in people with type 2 diabetes is low and most do not meet guideline recommendations

- Showed that modifiable factors including Action Control from HAPA and Goal Facilitation predict walking

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